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ABSTRACT

This issue of "ETS Policy Notes" discusses gender differences in educational achievement. The first article--"The Gender Gap in Education: How Early and How Large?"--discusses the National Assessment of Educational Progress (NAEP), which first measures achievement at age 9 years. Gender differences at that age are generally small, but significant in some academic subjects. By age 17, average scores for females are higher in reading and writing; with males, advantages are apparent in science and mathematics. Student attitudes begin to affect curriculum choices in the high school years and large differences emerge as college-bound seniors report their choice of intended college major. ETS publications reflecting data from the NAEP are listed at the end of the article. The second article--"Scholastic Ability"--considers the gender differences in performance on the Scholastic Aptitude Test (SAT) and the Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test (PSAT/NMSQT). Over the years, male and female verbal scores have converged, although males still outperform females in mathematics. Information on a more detailed report on gender differences in SAT takers is provided. The third article--"Sex Differences in Test Performance: A Synthesis of Research"--describes a comprehensive new summary of several decades of research on these gender differences, prepared by ETS researchers G. Wilder and K. Powel. This synthesis suggests that performance differences may be slowly diminishing, although women still lag in some aspects of spatial ability and achievement at the top levels of mathematics. (SLD)

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The Gender Gap in Education: How Early and How Large?

Any discussion of gender differences in educational achievement and choices inevitably stimulates vigorous discussion, and frequently disagreement. This is not surprising since perceptions of sex roles have been changing, and not always evenly among people of different ages, different racial and ethnic groups, different religions, and, of course, different genders. While this makes objective reporting on such differences a difficult task, it is no less necessary.

In the choices that young men and women make, the advice they receive, and the opportunities afforded them, there is continual interplay between cultural and social expectations and educational preparation and attainment. Anticipated occupational and societal roles help shape academic interest and performance. And choices made along the way, such as not to take advanced high school courses in science and math, for example, shape opportunity for further education and careers.

Achievement

Nine is the youngest age at which the National Assessment of Educational Progress (NAEP) measures achievement. While some gender differences have emerged by that age, they are generally small, although not insignificant in some subjects. In the 1984 reading assessment, girls scored an average of six points higher on the NAEP reading scale than boys (0-500), a decrease from the 12-point difference between girls and boys registered in the 1971 assessment. The gap at age 17 was 10 points in 1984, down slightly from 12 points in 1971.

It is difficult to characterize the importance of a six-point difference in the *average* scores of males and females on the NAEP reading proficiency scale. It helps, however, to look at the percentages of students who score at *levels* on the scale that NAEP has defined in terms of what students know and can do. As can be seen from Figure 1, by age 17, 44 percent of female students are at the 300 level, where they can find, understand, summarize, and explain relatively complicated information, compared with 35 percent of males. Still, judgment about the importance of the difference is subjective and varies with expectations and with the use made of a particular test.

The 1984 NAEP writing assessment showed a larger advantage for female students at all grade levels assessed (4, 8, and 11).

In science, NAEP assessments have consistently shown higher average performance for male students and increasing differences at older ages. In the 1986 assessment, the difference was six scale points at age 9. The differ-

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ence at age 13 was nine points, and at age 17, 13 points (down only a little from 1977). In addition to these average differences, gaps exist at different levels of proficiency. For example, only 5 percent of the 17-year-old female students score at or above the highest level defined on the NAEP science scale compared to 10 percent of males. At this level, students can integrate specialized scientific information. Among science subjects, the largest male advantages in proficiency by age 17 are in the quantitative areas of Physics, Chemistry, and Earth and Space Sciences. In Natural and Life Science, the differences are small and favor girls in the early grades.

In mathematics, no differences emerged by age 9 in the 1986 National Assessment; at that age, both sexes had average scores of 222. There was only a small difference in average performance at age 13, although a slight male advantage appeared in the higher ranges of the proficiency scale. By age 17, however, the average favored male students by six points, translating into a considerable advantage for male students at the highest score level (see Figure 2).

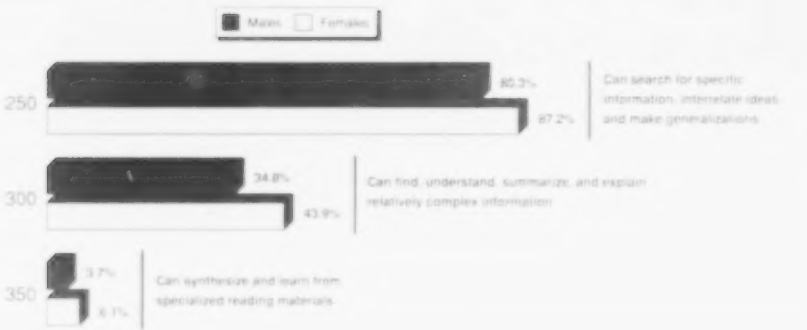
In the 1986 assessment, males outperformed females in History, while females did better in Literature.

Perceptions

The difference between girls' and boys' confidence in mathematics widens after grade 3. At grade 3, 66 percent of boys and 64 percent of girls said "yes" to the statement, "I am good with numbers." By grade 7, girls' confidence declined, and only 57 percent agreed that they were "good at mathematics." That figure fell to 48 percent by grade 11 (see Figure 3).

Somewhat fewer female students perceive that knowing science will help them earn a living or that it will be important in their life's work. While half of male students in grade 11 thought that they would "use science in many ways" as adults, this was true for only 42 percent of the young women. Thirteen percent fewer female than male students in grade 11 expected to work in an area requiring mathematics.

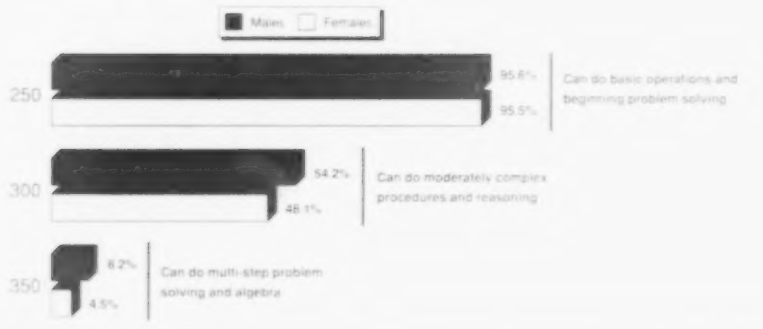
Figure 1
Percent of 17-Year-Old Male and Female Students Who Performed at the 250, 300, and 350 Levels in Reading, 1984



Mean Scores: Males - 283, Females - 293

Source: "The Reading Report Card," National Assessment of Educational Progress, 1984

Figure 2
Percent of 17-Year-Old Male and Female Students Who Performed at or above the 250, 300, and 350 Levels in Mathematics, 1986



Mean Scores: Males - 305, Females - 299

Source: "The Mathematics Report Card," National Assessment of Educational Progress, 1986

In a 1986 NAEP assessment of computer competence, seventh-grade boys and girls were both more likely to say that boys liked computers more, although a higher percentage of boys expressed this belief.

While divergence of attitudes toward and proficiency in mathematics emerges after age 9, differences in writing show up in NAEP's fourth-grade assessments. Sixty-four percent of fourth-grade girls report that they "like to write" most of the time, compared to 51 percent of the boys. By grade 8, the proportion of boys liking to write drops sharply to 29 percent. Despite their drop to 53 percent, the girls have an edge of 24 percentage points. In grade 11, there is little change: 28 percent of the male students and 51 percent of the females like writing (see Figure 4).

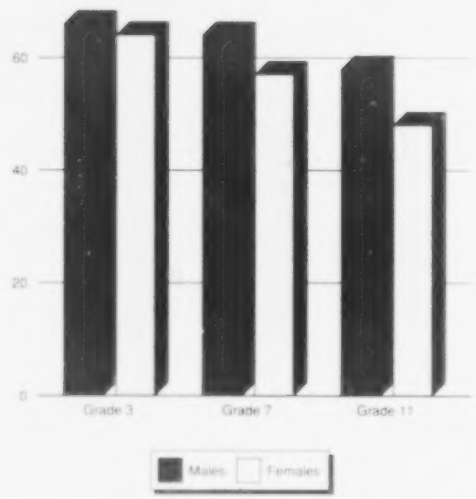
Seventy-seven and 80 percent of the male and female fourth-grade students, respectively, think writing is important; thus, there is little difference at that grade level. By grade 11, however, the percent for males drops to 64, and for females to 74, opening a gap of 10 percentage points.

The origins of these differences in attitude are not easily traced, but we can be sure that there is an interplay between attitude and subject matter proficiency.

The Courses

The attitudes that develop before high school, the successes and failures in particular subjects, and perceptions of appropriate — and attainable — occupations begin to affect student choices of curriculum in the high school years. On average, these choices

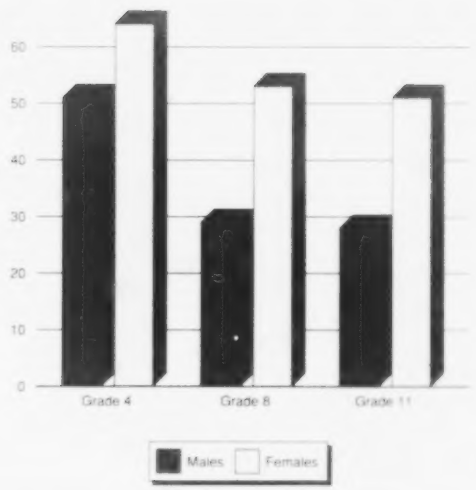
Figure 3
Percent of Male and Female Students Saying They Are Good at Math*



*Note: At grade 3, percent is students saying "I am good with numbers." At grades 7 and 11, percent is students agreeing or strongly agreeing with the statement, "I am good at mathematics."

Source: John A. Dossey, et al., "The Mathematics Report Card: Are We Measuring Up?" National Assessment of Educational Progress, Educational Testing Service, 1988, pp. 95-96.

Figure 4
Percent of Males and Females Who "Like to Write" Most of the Time



Source: National Assessment of Educational Progress, 1984 Writing Assessment, unpublished data.

differ somewhat between male and female students in many subjects.

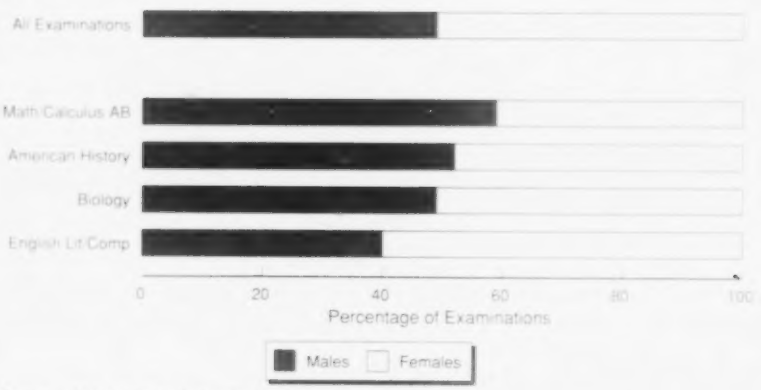
According to a national study of high school transcripts, male and female graduates of the class of '87 were about even in the percentages taking Algebra I and II. Male students were slightly ahead in taking Trigonometry and considerably ahead in taking Calculus, although few of either sex took it. The pattern in science was similar, with real differences emerging in the most advanced course, Physics, where 15 percent of female students had enrolled compared to 25 percent of male students.

Female eleventh graders were more likely than males to take vocational courses. Females were also more likely to have taken one or more years of business courses; 56 percent of females took these courses compared with 43 percent of males. A considerably larger percentage of males than females took courses in Agriculture, Auto Mechanics, the construction trades, Drafting, Electronics, Machine Shop, and Welding. Females were much more likely than males to enroll in Cosmetology, Home Economics, food-service occupations, and secretarial/office work courses.

There are also gender differences in students taking the most advanced academic courses in high school, Advanced Placement (AP) courses for which they can receive college credit. Overall, about as many female students take Advanced Placement examinations as do males. The largest numbers of AP examinations are in English Literature/Composition, American History, Math/Calculus AB, and Biology. Slightly more male than female students take examinations in History and slightly more females take Biology. Six out of 10 English literature and composition examinations are taken by female students; the reverse is true for Math/Calculus, with males constituting 59 percent (see Figure 5).

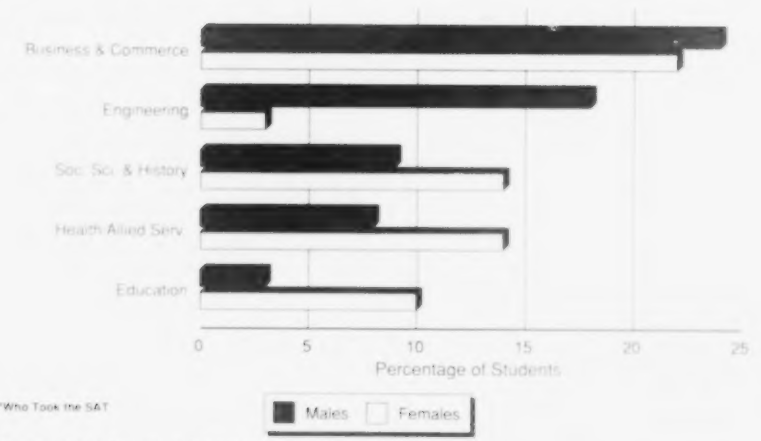
Large differences emerge as college-bound seniors report their intended majors on the Student Descriptive Questionnaire, filled out by more than a million students taking the Scholastic Aptitude Test (SAT) each year. Among the five most frequently chosen majors, Business and Commerce attract slightly more males than females, Engineering majors are predominantly male, and Social

Figure 5
Percentage of Advanced Placement Examinations Taken by Males and Females in All Subjects and in the Four Most Popular Subjects, 1988



Source: 1988 Advanced Placement Program National Summary Reports, College Board, 1988.

Figure 6
Most Frequently Planned Areas of Study, Male and Female College-Bound Seniors, 1988*



*Who Took the SAT

Source: "1988 Profile of SAT and Achievement Test Takers." The College Board.

Science/History, Health, and Education majors are heavily female (see Figure 6).

The pattern of difference in choice of majors continues into graduate school. When taking the Graduate Record Examinations, students declare their intended graduate school majors: Female students are 80 percent of those choosing Education, 70 percent of those choosing Comparative Literature, 65 percent of those choosing Anthropology, 50 percent of those choosing Biological Sciences, 41 percent of those choosing Mathematics, and only 15 percent of those choosing Physics or Engineering.

Unimpeded Opportunity

Comparison often results in the identification of differences. It should be kept in mind that through high school, male and female choices and performance are generally more similar than they are different. Sometimes the numerical differences seem small, as in the NAEP math scores. But these math differences become sizable at the top end of the scale and thus affect the opportunity of women to pursue course work in highly quantitative subjects.

Free choice means that individuals will make different decisions; what Americans want is that choices be made in an environment of unimpeded opportunity. The effects of stereotypes inherited from our cultural past can limit opportunity — and do so early in life. A girl turned away from mathematics by the subtle and less-than-subtle signals she receives has future opportunities foreclosed. While limiting signals are pervasive, their effects can be countered by extra effort in the home, the community, and the school. With support from the Ford Foundation, Educational Testing Service recently identified 109 math, science, and computer science intervention programs for female students in grades 4 through 8. An inventory with descriptions of the programs is now available, and a set of case studies of evaluated programs is nearing completion.

If opportunity is unimpeded — in all areas of life — and some differences remain, they are unlikely to be critical in the pursuit of common goals. Achievement in American education leaves lots of room for improvement on both sides of the gender gap.

Referenced data from the National Assessment of Educational Progress are available from ETS in the published "report cards" on mathematics (1986), science (1986), reading (1984), and writing (1984), unless noted as previously unpublished. Reports on the 1988 reading and writing assessments are forthcoming. *Intervention Programs in Math, Science, and Computer Science for Minority and Female Students in Grades Four Through Eight*, by Beatriz Chu Clewell, Margaret E. Thorpe, and Bernice Taylor Anderson, can be ordered by sending a check or money order for $6.00 per copy (payable to Educational Testing Service) to: ETS, Publication Order Services, P.O. Box 6785, Princeton, NJ 08541-6785. Specify item number 223420. ■■

Scholastic Ability

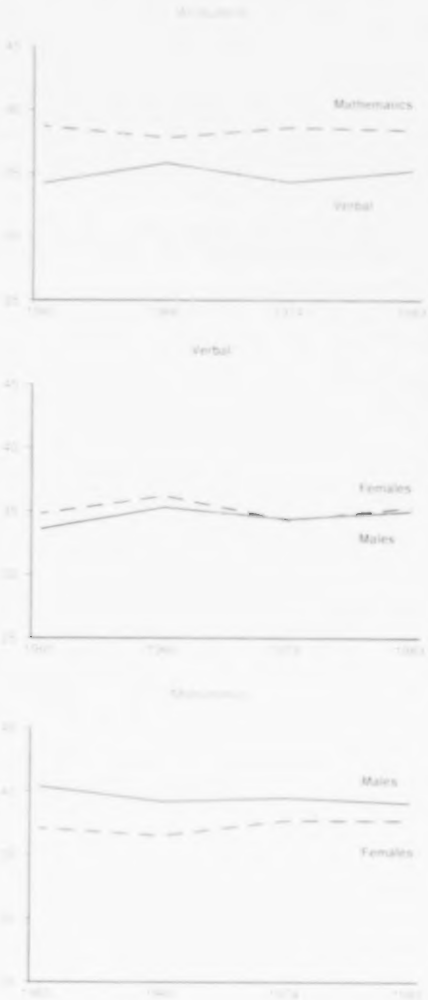
The Scholastic Aptitude Test (SAT) and the Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test (PSAT/NMSQT) understandably receive a lot of attention; they are often important in the educational careers of young people. Against the advice of the College Board and Educational Testing Service, scores on these tests are often used as measures of educational quality and progress; for example, state-level SAT data are presented in the annual "wall chart" of the Secretary of Education, or used by colleges to describe how good they are based on the average scores of their entering students.

These tests have important and specific uses for which they are validated. As direct measures of educational achievement in school, they are inappropriate for a number of reasons, including the fact that they measure developed ability acquired over a lifetime and are not tied directly to school curriculum, although school studies affect scores. Additionally, the test takers are not a representative sample of students, and the demographic composition of test takers may shift over time and varies from place to place.

The changing demographics of SAT and PSAT/NMSQT test takers have confounded comparison of how male and female students perform. These demographics were recently the subject of intensive study by Nancy W. Burton and her colleagues at ETS. They found that, on the average, women who choose to take the SAT today:

- Represent a larger segment of female high school graduates than the segment of male graduates represented by their male counterparts.
- Come from families with lower parental education and family income than do men who choose to take the SAT.
- Are less likely than their male counterparts to be attending private schools.
- Have lower rates of enrollment than men in academic programs generally, and in mathematics and science courses particularly.

Figure 7
Trends in PSAT Norming Study Results*



*Preliminary Scholastic Aptitude Test, administered to a nationally representative sample of 11th grade high school students.

Source: ETS Norming Studies for the PSAT/NMSQT: 1960, 1966, 1974, 1980.

All these factors are associated with SAT scores, and all have the effect of depressing women's scores relative to men's. On the other hand, some differences affect women's scores in the other direction, such as taking more foreign languages. The study concludes: "Because the men and women who take the SAT differ in so many ways, it is difficult to compare them."

Some of the problems of comparison would be solved if the SAT were given to nationally representative samples of students. For purposes of obtaining norming data, ETS periodically administers the PSAT/NMSQT, which is a shorter form of the SAT, to a representative sample of high school juniors. These results are little known and little used, although they were published in 1977 by the Blue Ribbon Panel investigating the widely reported SAT score decline in its report, *On Further Examination*:

> when the PSAT . . . was given in 1960, again in 1966, and once more in 1974, to national samples of 11th graders as a whole . . . these 'norming studies' showed a substantial stability in averages on both the Verbal and Mathematics sections over the entire 14-year period.

(continued on page 8)

Sex Differences in Test Performance: A Synthesis of Research

Performance differences between men and women on standardized tests may be slowly diminishing, according to a comprehensive new synthesis of research and test data by ETS researchers Gita Wilder and Kristin Powell. In many studies and tests, men appear to have caught up with women on tests of verbal ability and achievement, while women are gaining on — but not equaling — men in mathematics. Women still lag in some aspects of spatial ability and in achievement at the top levels of mathematics. That disparities have diminished is quite evident when nationally representative samples of students are examined, according to the authors.

Their report, *Sex Differences in Test Performance: A Survey of the Literature*, summarizes significant research conducted during the last several decades. In addition to reviewing hundreds of studies, the authors examined data from four sources: undergraduate, graduate, and professional school admission tests; validity studies; tests using nationally representative samples; and studies of differential performance on individual test items.

As the authors note, "The conclusions about gender differences that can be reached at the current time are limited," mainly because "the data that support many of the contentions made about gender differences and their cause are inconclusive and often contradictory." Nonetheless, the review supports several generalizations about performance on standardized tests:

- Many different tests given over a wide range of ages and educational levels still reveal male-female score differences.
- In general, the largest differences appear in tests of mathematical or quantitative ability, where men tend to do better than women, particularly in secondary school and beyond. In recent years, there is some evidence that this gap may be narrowing.
- Women have tended to do better than men in many tests of verbal skills (particularly writing), but a number of studies indicate that this superiority has diminished since the early 1970s.

Efforts to explain differences in test scores run the gamut from the biological to the psychosocial, from assertions of inherent biological differences between males and females through critical assessments of differences in social and educational experiences, to the characteristics of the tests themselves. Wilder and Powell found that no single explanation captured all the variance in the differences between males and females in the quantitative domain. Patterns of course-taking, attitudes toward mathematics, differences in achievement motivation, and some characteristics of the tests themselves may contribute to the differences but fail to explain them all. The cumulative effect of early socialization patterns and different educational experiences has also been identified as a likely (but not easily measured) contributor to performance differences.

Whatever the reasons for the differences, and however small they are becoming, the authors cite two reasons for continued concern. First, substantial educational and social consequences are attached to test performance in our society. Second, research suggests that individuals are psychologically affected by their success, or lack of it, on tests. Lesser performance on mathematics tests, for example, may cause females to lower their expectations, shy away from highly quantitative courses, and/or conclude that these fields are the province of males. Clearly, these concerns demand that research into the nature and causes of sex differences in test performance continue so that intervention efforts can be properly informed. The authors provide suggestions for the forms that future research should take.

The report was supported by the College Board and Educational Testing Service. Copies of *Sex Differences in Test Performance: A Survey of the Literature* are available at $6.00 each from the College Board. Request CB Report No. 89-3, Item Number 275974, enclosing a check or money order (payable to the College Board) or an institutional purchase order, from: College Board Publications, Box 886, New York, NY 10101-0886. ■

Scholastic Ability

(continued from page 6)

When the exercise was repeated in 1983, once again scores were stable over the entire period (see Figure 7).

The larger point for this discussion, however, is what these norming studies disclose about gender comparisons. By 1974, the Verbal scores of males and females converged (see Figure 7). For Mathematics, the scores have been coming together throughout the period, although representative samples of males still outscore their female counterparts, on the average, by 1.4 points on a scale of 20 to 80. This compares with a difference of 5.3 points for 17-year-old students on the NAEP mathematics scale of 0 to 500 (see Figure 2). These small differences take on greater significance at the top reaches of the NAEP proficiency scale: the proportion of male students scoring 350 or above is 82 percent higher than for females, although the high scorers are distressingly few for both sexes (see Figure 2).

While the administration of the PSAT to representative samples of students eliminates some sources of score differences, it does not get at several sources that have been the subjects of speculation and research, such as different course-taking patterns and academic interests, transmission of sex-role stereotypes, "math anxiety," and problem-solving abilities, to name a few.

For more detail on differences between male and female SAT takers, see Nancy W. Burton, Charles Lewis, and Nancy Robertson, *Sex Differences in SAT Scores*, College Board Report No. 88-9, 1988. To order, send a check or money order (payable to the College Board) or an institutional purchase order for $6.00 to College Board Publications, Box 886, New York, NY 10101-0886. Specify item number 218112. ■

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